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Is it probable that the number of visible comets within the sun's permanent influence will increase with the age of the system? The fact of frequent cometary dissolutions is no longer doubted, and it is evident that the process, if long continued, must render the original masses invisible, so that in after time the interplanetary spaces must be strewn with dispersed meteoroids. The sporadic meteors now observed in greater or less numbers every clear night may thus be regarded as the scattered debris of ancient comets. If, therefore, we accept LAPLACE's theory of an extraneous origin, the relative number of comets in the future as compared with the present must depend on the frequency of capture as compared with the rapidity of dissolution.

SOME NOTES ON ASTRONOMY IN SOUTH AMERICA.

By Milton Updegraff.*

Having recently returned from a residence of two years and four months (November, 1887, to March, 1890,) at the National Observatory at Cordoba, Argentine Republic, it is with pleasure that I accept the kind invitation of Professor Holden to write a short outline of my impressions of South American astronomy for the *Publications of the Astronomical Society of the Pacific.* I visited the observatories at La Plata and Santiago, and we intended on our return journey to the United States to visit the observatory at Rio de Janeiro, but circumstances rendered it impossible for us to land there. It is said that a fine observatory is also being built near Quito, within three miles of the equator. This, with what I shall say later concerning improvements at La Plata and Santiago, will show that some of the principal Governments of South America, in proportion to their resources, are spending an unusual amount of money on astronomy.

Cordoba.

The National Observatory of the Argentine Republic is so well known in the United States, through the writings of Dr. B. A. Gould, its founder and until recently its Director, that a few words as to the recent and present work of the institution will be sufficient.

The principal work of this observatory at present is the formation of a visual *Durchmusterung*, like those of ARGELANDER, KRUEGER and SCHOENFELD, to include all stars down to the tenth magnitude between 23½° south declination and the South Pole. The great extent and richness of the region to be covered and the inclusion of all stars down to the tenth magnitude will make the number of stars observed very great. This work is being carried on by Dr. JOHN M. THOME, the Director, with one assistant, by means of a four-inch telescope. The observations can be made only when the sky is very clear and the moon below the horizon.

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* Director of the Observatory of the State University, Columbia, Missouri.

During the two years ending last December, I used the REPSOLD meridian-circle there, observing Dr. AUWERS' "*Catalogue of 480 Fundamental Stars for Observation of Zones between 20° and 80° South Declination.*" These stars were observed completely, five times circle east, and then five times circle west. About 1,200 other stars were observed during the same time for various purposes, consisting largely of stars selected from the *Argentine General Catalogue*, so as to fill up vacant places in the AUWERS list, and observed for the detection of proper motions. I made in all, from November 14, 1887, to December 21, 1889, 11,590 determinations of position, in both right ascension and declination.

My wife, who was formerly Miss ALICE LAMB, of the Washburn Observatory, observed on occasional nights during the first few months, and made 830 observations. Dr. THOME also made about 340 meridian-circle observations; the total number made during this time is about 12,760—an observation in both right ascension and declination being counted once. All these were reduced to apparent place in declination by my wife, and the reductions in right ascension were made by myself. During last July and August I observed the planet *Victoria* and Dr. GILL'S list of comparison stars with the meridian-circle, securing twenty-six observations of the planet. Since the completion of the observations on the 480 stars the instrument has been used by my successor, Mr. LESTER C. TAYLOR, in observing certain stars of the *Durchmusterung*.

My observations were made without an assistant, and it is customary there for the observer using the meridian-circle to work alone, making the settings and pointings, reading the microscopes, etc., and recording the same, and meanwhile keeping his weather-eye upon the erratic chronograph, which has a surprising way of stopping short, without any premonitory symptoms whatever. I made many diagnoses, and applied many remedies to cure this malady, which was both chronic and acute, but without entire success. The circumpolar stars were observed by eye and ear, and those of a list of 54, whose places have been carefully determined, were used for determining the position of the instrument. The time stars used were those of the *American Ephemeris.*

Just previous to our departure last March a fine mounting for the twelve-inch photographic lens formerly used by Dr. GOULD, was received from WARNER & SWASEY. But, unfortunately, while being raised upon the pier intended for its reception, the steel tube fell from a height of several feet and was broken into two parts. Before we left, a local mechanic had succeeded in riveting the parts together.

Cordoba had in 1887 sixty-six thousand inhabitants. The climate is mild and in many respects agreeable, but is debilitating both in winter and summer. For a foreigner, the chief amusement is horseback-riding and traveling in the mountainous country which lies west of the city.

LA PLATA.

The La Plata Observatory is an institution built and maintained by the government of the Province of Buenos Ayres, and is situated at La Plata, the provincial capital, probably the finest city in the Argentine Republic, an hour and a half by rail southwest of the city of Buenos Ayres, near the historic town and seaport of Enseñada. When in Buenos Ayres last March, on my way back to this country, having a few hours at my disposal, I ran down to La Plata, and spent a short time at the observatory. The buildings of the observatory occupy a clear space in a beautiful grove of eucalyptus trees, not far from the residence of the Governor. The site of the observatory is only slightly elevated above high tide in the Rio de la Plata, but the shores of the great estuary are several miles distant.

Although a stranger to him, I was very kindly received by the distinguished Director, M. LE BOEUF, a man of fine presence and possessing a perfect command of the Spanish language. While evidently very busy, he stopped work to conduct me personally through all the principal buildings which were completed or in process of construction. He expressed it as his desire to secure not only the greatest possible solidity in the piers on which the instruments are to be mounted, but also a high degree of rigidity in the instruments themselves. Instead of having a single large observatory building, each instrument is to be mounted in a separate smaller building, in order to secure, as far as possible, isolation from local disturbing causes. The separate buildings are from one to two hundred feet apart, one story each; their walls and foundations are constructed with the greatest care, of brick, covered outside and ornamented with stucco, in the manner of the country, and the rooms within (as far as completed) are substantially, and even elegantly, finished. Of course, the foundations of the piers are laid very broad and deep in cement—the humid nature of the ground making this necessary. Four of this little village of ten or twelve houses are intended for meridian instruments. Two are unfinished, and one of these is to shelter a large meridian-circle of French make. The other two buildings of this class are completed, and have mounted in them a transit instrument, and a zenith telescope and transit combined.

These instruments are similar to each other and novel in pattern, and have been recently made in Paris from designs by M. LE BOEUF. Although not large instruments, the bed-plates, upright pillars, and, indeed, all parts, are very massively constructed. The exquisitely polished and rounded pivots may be said, without much exaggeration, to approach in size to the telescope tubes. The instruments are fitted with appliances for quick reversal and for otherwise facilitating the work of the observer, and are also nicely finished throughout. The observing-rooms in which these fine instruments are mounted are furnished with all modern improvements. Either gas or electricity may be used at pleasure, and the lamps are provided with ventilating tubes for carrying off the heated air, which would otherwise pour out through the slit and spoil the definition. Such refinements as these are not universally used in South American observatories. These instruments were nearly, if not quite, ready for use, and M. LE BOEUF mentioned, as one of the many uses for which they are intended, the determination of difference of personal equation by simultaneous observation of the same stars.

There are also a building for meteorological and magnetic observations, a large pier for a reflecting telescope, with building to shelter it (not yet finished), a building for a telescope of the *coudé* form (in construction), and several smaller structures, besides the astronomer's house. The latter edifice is a fine one-story house, built around an interior court, in the Spanish style. It contains the private apartments of the Director and other astronomers, and a fine library-room, offices and computing-rooms. On the north front is a wide portico, the roof of which is supported by massive fluted columns. Within it, cut in the main wall of the house, are four niches, intended for life-size statues of NEWTON, GALILEO, KEPLER and LAPLACE, the names of these illustrious astronomers being inscribed above in large gold letters. On the south front is a smaller portico, having niches for statues of Bessel and Arago.

Having seen this, and much more which I do not now recall (as I took no notes), after bidding good-by to M. Le Boeuf, and thanking him for his kind attention, I hurried away to catch the train for Buenos Ayres, with an impression that this large institution, in process of development under the great difficulties peculiar to the country and location, will, nevertheless, with its ample resources and efficient direction, become a great and useful centre of scientific activity.

Santiago.

During the month of January last, I visited Santiago, the capital of Chili, and sought the place where the American astronomer Gilliss and afterward the German astronomer Moesta each made a series of observations on the remarkable isolated rock called "El Cerro de Santa Lucia," in the years 1849–1854. In 1854, Moesta removed the instruments from Santa Lucia to the new National Observatory, which had been erected in the "Quinta Normal," a fine park in Santiago. Since that time the hill or mountain of Santa Lucia has been transformed by the skill of the landscape gardener into one of the most beautiful ornaments that any city in the world can boast. This work involved the blasting away of rock and the building up of walls to such an extent as to render the exact location of any point on the original surface of the mountain difficult or impossible without a knowledge of both the horizontal and vertical co-ordinates from some known point. From Moesta's description of the location of the observatory *(Tomo I, Observatorio Nacional de Chile)** and from an engraving, which is the frontispiece of the same book, it is known that the two wooden houses which constituted Gilliss' observatory were about half-way up the mountain on the north side. I was naturally somewhat disappointed not to find the place marked in some way, or, rather, not to be able to find the place at all, and on inquiring about it was told that no mark or monument exists on the spot and that the exact place is probably forgotten. On my mentioning this matter to the Hon. PATRICK EGAN, United States Minister to Chili, he said that he considered it an appropriate and desirable thing to have the place found and suitably marked by a tablet or monument. He suggested that, probably, the best way to locate the spot would be to consult the records of the city engineers of Santiago, and, if necessary, to have a survey made. Mr. EGAN also said that if he were furnished with the proper inscription for such a tablet or monument, he would have the exact spot located as accurately as possible, ask the consent of the authorities, and have the place suitably marked. The place can be located approximately, if not very accurately; and the interest which Mr. EGAN takes in erecting a monument there will make it very easy to have the matter properly attended to, provided the Astronomical Society of the Pacific, or any member of it, should feel disposed to co-operate with him for that purpose.*

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* I have extracted the following data from this book:

"About Sept. 15, 1852, Gilliss turned over the instruments of the observatory which had become the property of the Chilian Government, and which were valued at 7939 pesos, to Moesta. The instruments were a meridian-circle by Pistor and Martins, two equatorial telescopes of $6\frac{4}{10}$ in. and 4 in. aperture, a clock, two chronometers and other small instruments. There were also some books and two small wooden houses on Santa Lucia in which the instruments were mounted—in one of them the meridian-circle, and in the other one or both of the equatorial telescopes. The equatorial house had a conical roof and turned about on cannon balls. The houses were situated on two platforms, made by hewing the rock away on the north side of the mountain. The equatorial house was $16\frac{3}{10}$ metres to the south of and $5\frac{2}{10}$ m. higher up than the meridian-circle house. The cistern of the barometer in the meridian-circle house was $58\frac{9}{10}$ m. higher than the center of the Plaza Principal of Santiago, the elevation of this latter point above sea being $559\frac{6}{10}$ m., according to railway levels. Therefore the height of the barometer above sea-level was $618\frac{5}{10}$ m. (= 2029 ft.)."

The horizontal co-ordinates do not seem to be given for either of the houses of the observatory by Moesta. Whether they are given by Gilliss in his report I do not know. Moesta disagrees with Gilliss as to the elevation of the site of the observatory.

I also visited the National Observatory of Chili, in Santiago, pleasantly situated in the beautiful botanical garden called the "Quinta Normal." The present Director is M. OBRECHT, formerly of the National Observatory of Paris. He kindly showed us about the institution, and we saw a fine-looking equatorial telescope of ten or twelve inches aperture, and a large new meridian-circle (eight inches, I think,) of French make, which was just being mounted. As I remember it, the dimensions of the "cube" of this instrument cannot be less than fifteen inches. The Director said that he was about to erect additional buildings, and to get more and better instruments.

While we were in Santiago, Mr. EGAN told me that two gentlemen from Peru, belonging to the Harvard College Expedition to the Southern Hemisphere, had lately been in the city, looking for a better location for their observatory than the one they then occupied near Lima. I afterward received, through the kindness of Mr. EGAN, a copy of *El Ferro-carril*, a newspaper of Santiago, for February 19th, in which is printed a letter written by one of these gentlemen, giving an account of their work in South America. I have translated that part of the letter which appears to me to be of interest here. Any one who has experienced the hardships incident to life in the more arid parts of South America will appreciate the difficulties under which the Harvard College observers must labor in the Desert of Atacama. It is a very desolate country indeed, that is called a desert in South America:

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* A paragraph in the New York *Sun* of March 30 announces that Mr. EGAN has recently made arrangements to erect such a tablet.

"DESERT OF ATACAMA, PAMPA CENTRAL, CHILI,
January 29, 1890.

"TO HON. PATRICK EGAN, *Envoy Extraordinary and Minister Plenipotentiary from the United States of America, Santiago de Chili:*

"SIR:—When, some weeks since, I had the pleasure of seeing you in Santiago, you asked me to communicate to you in writing, for communication to our Government and that of Chili, some details with respect to the work of our expedition,—a task which I now undertake with pleasure.

"The astronomical expedition, which is in charge of my brother, S. J. BAILEY, M. A., and in which I have the honor to occupy the position of first assistant, was sent out by the Astronomical Observatory of Harvard University about a year ago, and during this time has been engaged in work of great importance; at first in Peru, and at present in Chili.

"I will first give you a review of what the expedition has accomplished up to the present time, and of the plan of work which it is proposed to accomplish. The work of the observatory at Cambridge is mostly confined to the northern heavens, although some work is done as far south as — 30°. In order to make observations from this limit to the South Pole, it is necessary to occupy a position south of the Equator. For this purpose the necessary arrangements for establishing an astronomical station at some point in Peru were made during the last six months of 1888 by Professor E. C. PICKERING, Director of the observatory. The expedition was sent out in February, 1889. It has been demonstrated both by the experience of observers of the staff of the Harvard College Observatory, who were stationed on Wilson's Peak, in Southern California, and by the observations of other astronomers, that stations situated on the Pacific Coast, at a certain elevation above the level of the sea, are particularly favorable for astronomical work, because of the transparency of the atmosphere and the prolonged seasons of clear weather which every year affords. After spending some weeks in looking over the country, therefore, the summit of a mountain 6650 feet high was chosen, the mountain being eight miles north of Chosica, Peru, and twenty-eight miles further inland than Lima. The situation was high enough to be always from one to three thousand feet above the fogs of the coast, and far enough from the interior to escape its rains. Two portable houses had been brought from the United States and three other small houses were built on the mountain for the use of the assistants, servants, etc.

"The instruments employed in the observations are a photographic telescope of eight inches aperture, a meridian photometer, with lens of six inches aperture, and various meteorological and other instruments. The mountain peak selected was named Mount Harvard. Observations were begun there on the first of last May. During the following four months more than 1200 negatives were obtained with the photographic telescope. The plan is to cover the firmament four times from 15° to the South Pole: the first time with photographs of an hour's exposure, which will include the spectra of all stars down to about the eighth magnitude; the second time with an exposure of ten minutes, which will give us the spectra of the more brilliant stars; the third time with plates of an hour's exposure, which will give us a map of the southern stars down to the fourteenth magnitude, inclusive; the fourth time with plates of ten minutes' exposure, which will include stars down to about the tenth magnitude.

"The meridian photometer is a double telescope, constructed especially for the purpose of making a more exact determination of the star magnitudes than has yet been attempted in the southern heavens. During the first four months of which we speak, more than twenty-six thousand measures of brightness have been made and recorded. During September and October the sky was so clouded that at the beginning of November Mr. S. J. BAILEY resolved to leave the station at Mount Harvard in charge of the second assistant, while he and I should examine various points along the southern coast to obtain meteorological and other data. We visited the cities of Arequipa, Preno, La Paz, Iquique, Autofagasta, Caldera, Copiapo, Valparaiso, Santiago, and many other points of less importance, but of interest for our work. The chief object of these investigations was to find a locality free from clouds, with an unobstructed horizon, which could be easily reached from the coast by railway. At last we installed ourselves, on the 6th of January of this year, in the Pampa Central, Desert of Atacama, 136 kilometers from Autofagasta, and at an elevation of 1382 meters (4533 feet); and here we have been since that time, working with the meridian photometer, which was sent to us from Peru as soon as this locality had been selected. Of the twenty-three nights since the date mentioned, twenty-two have been good working nights and seventeen of these perfectly clear. Fogs are entirely unknown here, and it is doubtful whether there is a clearer sky in Chili or in all South America. The admirable clearness of the heavens has greatly facilitated our work. In four nights we have measured the respective magnitudes of 890 stars, and by the 25th of February we hope to complete 6,000 of these observations, all made in the Pampa Central. After that date we shall return to Peru and continue the work at Mount Harvard during the clear season, until next spring, when it is not improbable that the station may be removed to the south, to a locality more exempt from clouds during the summer; perhaps to Arequipa or the Pampa Central itself, where the average number of clear nights during the year seems to be much greater than at Mount Harvard."

The writer goes on to speak of the BRUCE photographic telescope, now being made by the CLARKS, and states that it will undoubtedly be sent to South America after having been used to photograph the northern skies.

On our homeward journey, when among the Windward Islands, going from Martinique to St. Thomas, about April 20th, lat. 15° N., long. 60° W. from Greenwich, we saw the most interesting half of the celestial sphere which is visible at any latitude. There was no wind, the sea was remarkably calm, and (what is most unusual at sea) the evening sky was perfectly clear. To the north was our old friend *Polaris* and the Great Bear, while in the south, standing vertical on the meridian at an altitude of fifteen degrees and sinking slowly downward, was the Southern Cross. To the left of the Cross, just rising above the horizon, were α and β *Centauri*, and to the right *Sirius* and *Procyon*, *Orion* and *Taurus*, while overhead were *Arcturus*, *Regulus* and the planet *Saturn*. The Milky Way spanned the southwestern sky, and in the dense and knotted portion near the Cross showed in deep contrast the black void known as the "coal sack." On the western horizon glowed *Aldebaran*, and out from the faint twilight "the sweet influence of the *Pleiades*" shone upon us, while *Venus* and the thin crescent of the new moon lent their graceful presence to the scene. As to the latter, it was well that she came in the modesty and beauty of youth, for later in life the radiance of her rough red visage would have blotted out the more delicate beauties of the sky. Later, the Zodiacal Light loomed up conspicuously in the west, but in the east the "Gegenschein," or "counter-glow," was obscured by the combined glory of *Mars* and *Antares*, low down on the horizon, and of *Jupiter*, still below it. I was surprised to see what a monopoly we had of the brighter stars and constellations, and the display was one which would not only fire an amateur astronomer with enthusiasm, but might well overcome the apathy of the most professional of professionals. And thus, after a pleasant acquaintance of two years' duration, we bade farewell to the stars of the southern sky.

CORRIGENDA TO v. OPPOLZER'S "LEHRBUCH ZUR BAHNBESTIMMUNG DER KOMETEN UND PLANETEN."

By Armin O. Leuschner.

I have the honor to communicate to the Society a list of corrigenda to v. Oppolzer's "*Lehrbuch zur Bahnbestimmung der Kometen und Planeten.*" This work is now and will long remain a standard book upon the subjects which it treats, not only for the learner, but also for the practiced computer. It is therefore a matter of some importance as well as of great convenience to have the text freed of misprints and other errata.

The work consists of two volumes; and of volume I, two editions have been printed,—namely, the first edition in 1870, and the second in 1882. Volume II is still in its first edition, and was published in 1880.

Each volume contains a table of the errata detected during the passage of the work through the press. In 1880 Professor v. Oppolzer printed a long list of corrections to volume II. This list may be obtained by application to the publisher (W. Engelmann, of Leipzig). The present paper takes no account of the lists just mentioned, since they are available to every one who owns the work. Since 1880 corrigenda by various astronomers have appeared, from time to time, in the *Astronomische Nachrichten*, and for convenience I have collected these, and they are printed in what follows, with a